

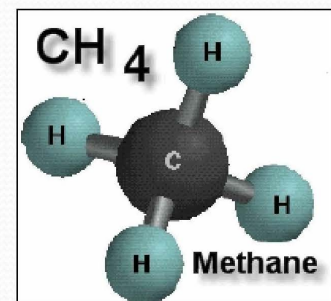
A blue background with a wavy, layered design at the top, transitioning from a darker blue to a lighter blue.

Isotech - Stable Isotope Analysis

Determining the origin of methane

Methane is the principal hydrocarbon detected in all stray natural gas migration incidents

- Exposure limit (gas phase): TLV-TWA: 1,000 ppm (ACGIH, 10/2009)
- Methane (CH₄) is the simplest paraffin hydrocarbon gas
- Methane is generated by microbial & thermogenic processes
- Flammable, colorless, odorless.
- Specific gravity: .555 (NTP)
- Explosive range: 5-15% in ambient air
- Solubility in water: 26-32 mg/l (1 atm.)
- Non toxic, no ingestion hazard
- Simple asphyxiant, explosion hazard



Methane can migrate as free gas or dissolved in the groundwater

Isotope Geochemistry

Carbon & Hydrogen Isotopes

Various researchers have determined by examination of stable carbon and hydrogen isotopes of methane and C₂+ hydrocarbons that there are common hydrogen and carbon isotopic compositions for thermogenic gas associated with coal and natural gas, drift gas, and other near-surface microbial gases.

The isotopic and compositional variations in natural gas can (principally) be described in terms of:

- 1) processes during the formation of gases : (bacterial fermentation, maturation of organic matter)
- 2) processes during secondary migration : (mixing , microbial oxidation, fractionation).

The carbon and hydrogen isotopic compositional ranges of methane from different sources are based on the genetic classification scheme of Schoell (1980)

Stable carbon & hydrogen isotope compositions are expressed as the ratio of ¹²C to ¹³C and ²H/¹H of the sample compared with that of the international standards...expressed in the following notation as per mil.

$$\delta R_x (\text{‰}) = \left(\frac{R_a / R_b \text{ sample}}{R_a / R_b \text{ standard}} - 1 \right) \times 10^3$$

(Craig, 1953; Coleman and others, 1977; Deines, 1980; Schoell, 1980; Rice and Claypool, 1981; Schoell, 1983; Whiticar, 1986; Wiese and Kvenvolden, 1993; Coleman, 1994; Baldassare and Laughrey, 1997; Kaplan and others, 1997; and Rowe and Muehlenbachs, 1999; Osborn and McIntosh, 2010).



ANALYSIS REPORT

Lab #: 235488 Job #: 17407
Sample Name/Number: HW02z
Company: TechLaw, Inc.
Date Sampled: 1/25/2012
Container: Dissolved Gas Bottle
Field/Site Name: A3TA

Location:

Formation/Depth:

Sampling Point:

Date Received: 2/03/2012 Date Reported: 2/20/2012

Component	Chemical mol. %	$\delta^{13}\text{C}$ ‰	δD ‰	$\delta^{18}\text{O}$ ‰
Carbon Monoxide -----	nd			
Hydrogen Sulfide -----	na			
Helium -----	0.0112			
Hydrogen -----	nd			
Argon -----	0.628			
Oxygen -----	0.80			
Nitrogen -----	40.72			
Carbon Dioxide -----	0.094			
Methane -----	57.06	-29.30	-160.6	
Ethane -----	0.687			
Ethylene -----	nd			
Propane -----	nd			
Propylene -----	0.0001			
Iso-butane -----	nd			
N-butane -----	nd			
Iso-pentane -----	nd			
N-pentane -----	nd			
Hexanes + -----	nd			
Water -----			-64.6	-9.66

Total BTU/cu.ft. dry @ 60deg F & 14.7psia, calculated: 590

Specific gravity, calculated: 0.736

